FEDERAL LAW ENFORCEMENT
WIRELESS USERS GROUP
WASHINGTON, D.C.

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March 10, 2000

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Magalie Roman Salas
Secretary
Federal Communications Commission
TW-A325
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: Comments in Response to U.S. West Wireless Petition for Reconsideration of the Commission's First Report and Order in WT Docket No. 96-86

Dear Ms. Salas:

On behalf of the Federal Law Enforcement Wireless Users Group (FLEWUG) and pursuant to Section 1.429 of the Commission's rules, 47 C.F.R. § 1.429, enclosed herewith for filing are an original and four (4) copies of the FLEWUG's Comments to a Petition for Reconsideration filed by U.S. West Wireless, LLC in the above-referenced proceeding.

Kindly date-stamp the additional, marked copy of this cover letter and return it in the envelope provided.

Should you require any additional information, please contact the undersigned.

Respectfully submitted,

James J. Flyzik
Deputy Assistant Secretary (Information Systems)
Chief Information Officer,
Department of the Treasury, and
Vice Chair, Government Information Technology
Services Board

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
Service Rules for the 746–764 and 776–794 MHz Bands, and Revisions to Part 27 of the Commission's Rules	)	WT Docket No. 99–168

FEDERAL LAW ENFORCEMENT WIRELESS USERS GROUP'S COMMENTS ON THE U S WEST WIRELESS, LLC PETITION FOR EXPEDITED RECONSIDERATION

1. Pursuant to Section 405(a) of the Communications Act of 1934, as amended[1] and Section 1.429(a) of the Federal Communications Commission's (Commission) rules,[2] the Federal Law Enforcement Wireless Users Group (FLEWUG)[3] respectively submits comments on the US West Wireless, LLC (US West) Petition for Expedited Reconsideration of the Commission's First Report and Order *In the Matter of Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules* (First R&O).[4]

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[1] 47 U.S.C. § 405(a).

[2] 47 C.F.R. § 1.429(a).

[3] The FLEWUG comprises law enforcement and public safety officials from the Department of the Treasury, Department of Justice, Department of the Interior, Department of Agriculture, Department of Defense, Department of Health and Human Services, United States Postal Service, United States Postal Inspection Service, National Telecommunications and Information Administration, Federal Emergency Management Agency, Internal Revenue Service, Federal Bureau of Investigation, United States Secret Service, United States Coast Guard, United States Capital Police, Drug Enforcement Administration , United States Park Police, Immigration and Naturalization Service, United States Customs Service, Bureau of Alcohol, Tobacco, and Firearms, United States Mint, National Communications System, Defense Information Systems Agency, National Security Agency, Federal Law Enforcement Training Center, Bureau of Engraving and Printing, United States Marshals Service, National Institute of Standards and Technology, United States Forest Service, United States Fish and Wildlife Service, and Federal Bureau of Prisons.

[4] Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules, WT Docket. No. 99-168, *Report and Order*, FCC 00-5 (rel. Jan. 7, 2000); Petition for Expedited Reconsideration of US West Wireless, LLC, WT Docket. No. 99-168 (filed Feb. 3, 2000).

I. STATEMENT OF INTEREST

2. In 1993, the Office of the Vice President issued a National Performance Review (NPR) report recognizing the need to improve public safety communications. The NPR, now known as the National Partnership for Reinventing Government (NPRG), and a subsequent Memorandum of Understanding between the Department of Justice and the Department of the Treasury, formally established the FLEWUG. The FLEWUG's membership includes more than 30 federal departments and agencies with law enforcement and other public safety responsibilities. Among the FLEWUG's critical objectives are the planning, implementation, and coordination of, shared-use, wireless communications systems and resources. Toward this end, the FLEWUG supports the development of shared-resource, shared-use wireless communications systems; the efficient use of the spectrum; and interoperability, as needed, among local, state, and federal public safety agencies.

3. Given the FLEWUG's charter, it has clear interests in the proceeding related to the First R&O, particularly regarding the protection of public safety receivers in the 764-776 MHz and 794-806 MHz bands. The FLEWUG believes that the recommendations made by US West in their petition regarding the out-of-band emission limits for commercial transmitters operating in the 747-762 MHz and 777-792 MHz bands are in direct conflict with the guidance provided to the Commission by Congress, whereby protection is to be given to public safety users that are developing systems to support nationwide interoperability between local, state, and federal law enforcement agencies.[5] In submitting these comments, the FLEWUG strongly urges the Commission to reject the recommendations made by US West regarding the out-of-band emissions limits for commercial transmitters operating in the 747-762 MHz and 777-792 MHz bands.

[5] H. Conf. Rep. No. 105-217, at 12 (1997), *reprinted at* 1997 U.S.C.C.A.N. 201.

II. THE COMMISSION SHOULD NOT CONSIDER ALTERNATIVE ARRANGEMENTS REGARDING THE OUT-OF-BAND EMISSION LIMITS THAT ARE REQUIRED TO PROTECT PUBLIC SAFETY RECEIVERS

4. The US West Petition recommends that the Commission allow commercial and public safety licensees to reach *"alternative arrangements"* regarding the out-of-band emission limits for commercial transmitters operating in the 747-762 MHz and 777-792 MHz bands (700 MHz bands).[6] The FLEWUG disagrees with the approach recommended by US West, where it is implied that commercial and public safety licensees would be permitted to independently coordinate or negotiate the limits on out-of-band emissions for commercial transmitters in the 700 MHz bands. The FLEWUG agrees with the current approach taken by the Commission where out-of-band emission limits for commercial transmitters in the 700 MHz bands that protect adjacent band public safety receivers will be included as part of the equipment type acceptance process. This will ensure that 764-776 MHz and 794-806 MHz public safety receivers nationwide can operate free from interference, which is consistent with the guidance provided to the Commission by Congress and is necessary for the successful development of interoperable systems for law enforcement. Therefore, the FLEWUG strongly urges the Commission to reject the US West recommendation to use alternative arrangements regarding the out-of-band emission limits for commercial transmitters operating in the 700 MHz bands.

III. A LIMIT ON OUT-OF-BAND EMISSIONS OF 43 + 10 LOG (POWER) FOR COMMERCIAL TRANSMITTERS OPERATING IN THE 700 MHz BANDS WILL NOT PROVIDE ADEQUATE PROTECTION TO ADJACENT BAND PUBLIC SAFETY RECEIVERS

5. The US West Petition recommends a minimum required attenuation of 43 + 10 Log (Power) or 80 dB for commercial transmitters operating in the 700 MHz bands.[7] However, US West does not provide an analysis of whether these out-of-band emission limits will adequately protect adjacent band public safety receivers. The FLEWUG analysis provided in Attachment A assesses the impact that the out-of-band emission limit recommended by US West for

[6] US West Petition at 8.

[7] US West Petition at 8.

commercial transmitters in the 700 MHz bands will have on adjacent band public safety receivers. As shown in this analysis the distance separations that are required between commercial base and mobile transmitters and public safety base and mobile receivers to preclude interference are extremely large and will disrupt the reception of public safety communications over much of its coverage area. The results of this analysis support the Commission's decision to adopt more stringent limits on out-of-band emissions for the commercial transmitters in the 700 MHz bands in order to provide adequate protection to public safety receivers operating in the adjacent bands. Based on the analysis provided, the FLEWUG strongly urges the Commission to reject the US West recommendation to use 43 + 10 Log (Power) as the minimum required attenuation for the commercial transmitters operating in the 700 MHz bands.

IV. A LIMIT ON OUT-OF-BAND EMISSIONS OF 65 + 10 LOG (POWER) FOR COMMERCIAL BASE TRANSMITTERS OPERATING IN THE 700 MHz BANDS WILL NOT PROVIDE ADEQUATE PROTECTION FOR ADJACENT BAND PUBLIC SAFETY RECEIVERS

6. The US West Petition recommends a limit on the out-of-band emissions of commercial base station transmitters operating in the 700 MHz bands of 65 + 10 Log (Power).[8] This out-of-band emission limit would be applicable to commercial base transmitters with antenna heights below 30 feet (height above average terrain).[9] However, the US West Petition does not provide an analysis of whether the recommended out-of-band emission limit of 65 + 10 Log (Power) for commercial base transmitters with a maximum effective radiated power limit of 1000 Watts would provide adequate protection to adjacent band public safety receivers. The FLEWUG analysis provided in Attachment B assesses the impact that the out-of-band emission limit recommended by US West for commercial base transmitters operating in the 700 MHz band will have on adjacent band public safety receivers. As shown in this analysis, the distance separations that are required between a commercial base transmitter with a limit on out-of-band emissions of 65 + 10 Log(Power) and public safety base and mobile receivers is large, even with a limit on antenna height of 30 feet. The results of this analysis support the Commission's decision to adopt a more stringent out-of-band emission limit for commercial base transmitters

[8] US West Petition at 9.

adjacent band public safety receivers can be accommodated without reducing the utility of the 700 MHz bands.

VI. THE OUT-OF-BAND EMISSION LIMITS ADOPTED IN THIS PROCEEDING ARE INDEPENDENT OF THE SPECIFIC TECHNOLOGY TO BE EMPLOYED BY THE PUBLIC SAFETY RECEIVERS

9. The US West Petition claims that because of the uncertainties regarding the equipment that public safety agencies will actually deploy there is no meaningful opportunity to determine whether the out-of-band emission limits adopted by the Commission are genuinely necessary to protect public safety receivers.[15] The FLEWUG disagrees with the claim made by US West. In this proceeding the out-of-band emission limits necessary to protect public safety receivers that were recommended by various commenters were based on a general interference threshold[16] that is related to an increase in the noise floor of the receiver.[17] An interference threshold that is based on the noise floor of the receiver will be independent of the specific technology employed by the public safety equipment. The technical parameters that were considered in the development of the interference threshold for the public safety receivers include: bandwidth, noise figure, and cable/insertion losses. In general these technical parameters will be standard for all public safety receivers regardless of the specific technology that will be employed.[18] Therefore, the FLEWUG believes that the out-of-band emission limits that are necessary to protect public safety receivers can be established without knowledge of the specific technologies that will be deployed by the public safety agencies.

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[15] US West Petition at 7.

[16] The interference threshold establishes the maximum allowable level of interference that a receiver can tolerate before performance is degraded.

[17] *Ex Parte* Comments, WT Docket. No. 99-168: Motorola Inc. (Dec. 2, 1999) at 2; FreeSpace Communications (Nov. 24, 1999) at 3; and the Federal Law Enforcement Wireless Users Group (Dec. 9, 1999) at 6.

[18] The standard bandwidth for public safety receivers is 6.25 kHz; the minimum and maximum receivers noise figures will vary by approximately 2 dB; and the cable/insertion losses can be estimated within 1 to 3 dB.

operating in the 700 MHz bands in order to provide adequate protection to public safety receivers operating in the adjacent bands. Therefore, the FLEWUG strongly urges the Commission to reject the US West recommendation to adopt an out-of-band emission limit of 65 + 10 Log (Power) for commercial base transmitters operating in the 700 MHz bands.

V. WIDEBAND THIRD GENERATION WIRELESS TECHNOLOGIES THAT PROVIDE ADEQUATE PROTECTION TO ADJACENT BAND PUBLIC SAFETY RECEIVERS CAN BE ACCOMMODATED WITHOUT COMPROMISING THE UTILITY OF THE 700 MHz BANDS

7. The US West Petition claims that the out-of-band emission limits adopted by the Commission in the First R&O could significantly reduce the utility of the 700 MHz bands, for current and future Code Division Multiple Access (CDMA) based technologies.[10] However, as part of the record in this proceeding, one manufacturer that will be developing third generation (3G) wireless technologies in the 700 MHz bands provided an analysis showing how wideband CDMA (W-CDMA)[11] technologies can be accommodated in the band while providing protection to adjacent band public safety receivers that is more stringent than the limits that have been adopted by the Commission in the First R&O.[12]

8. W-CDMA technologies will require a wider bandwidth than many of the other 3G technologies that are envisioned for the 700 MHz bands, and therefore probably represents a worst-case situation for filtering out-of-band emissions.[13] The analysis, which is based on reasonably achievable filtering technologies, shows how an out-of-band emission level of -57 dBm (-87 dBW) and be achieved.[14] This out-of-band emission level is 11 dB lower than any of the out-of-band emission limits adopted by the Commission in the First R&O for commercial transmitters operating in the 700 MHz bands. Based on this analysis, the FLEWUG believes that wideband 3G wireless technologies employing out-of-band emission limits that will protect

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[9] *Id.* on previous page.
[10] US West Petition at 9.
[11] W-CDMA is a direct sequence technology with a 3.84 Mcps spreading rate.
[12] *Ex Parte* Notification, WT Docket. No. 99-168, Motorola Inc.(Dec. 3, 1999), at 1.
[13] Third generation cellular standards have three main sets of criteria: a mobile data rate of 144 kbps, a portable data rate of 384 kbps, and an in-building fixed data rate of 2 Mbps.
[14] Motorola Ex Parte at 1.

VII. CONCLUSION

10. For the forgoing reasons, the FLEWUG urges the Commission to reject the recommendations made by US West regarding the out-of-band emission limits for commercial transmitters operating in the 747-762 MHz and 777-792 MHz bands.

Respectfully submitted,

James J. Flyzik
Deputy Assistant Secretary (Information Systems)
Chief Information Officer,
Department of the Treasury, and
Vice Chair, Government Information Technology
Services Board

ATTACHMENT A

ANALYSIS OF THE US WEST PROPOSAL FOR A MINIMUM OUT-OF-BAND EMISSION LIMIT OF 43 + 10 LOG (POWER) FOR COMMERCIAL TRANSMITTERS OPERATING IN THE 700 MHz BANDS

INTRODUCTION

In their Petition for Reconsideration US West recommended a minimum required attenuation of out-of-band emissions for commercial transmitters in the 700 MHz bands of 43 + 10 Log (Power) or 80 dB. If it is assumed that the 764-776 MHz band is used for public safety base-to-mobile communications and the 794-806 MHz band is used for public safety mobile-to-base communications, there are four interference scenarios that should be considered:

1) commercial base transmitter and public safety mobile receiver;
2) commercial base transmitter and public safety base receiver;
3) commercial mobile transmitter and public safety mobile receiver;
4) commercial mobile transmitter and public safety base receiver.

This analysis will determine the potential interference to public safety receivers from transmitters that comply with the out-of-band emission limit of 43 + 10 Log (Power) recommended by US West. The potential for interference will be expressed in terms of the distance separation that is required to preclude interference to the public safety receiver.

ANALYSIS METHODOLOGY

The power of the interfering signal from the commercial transmitter at the input of a public safety receiver is found using the following equation:

$$I = P_T + G_T + G_R - L_P - FDR - L_{tx} - L_{rx} \qquad (1)$$

where

P_T is the transmitter power of the commercial transmitter (dBm);
G_T is the antenna gain of the commercial transmitter (dBi);
G_R is the antenna gain of the public safety receiver (dBi);
L_P is the propagation loss between the commercial transmitter and the public safety receiver (dB);
FDR is the frequency dependent rejection (dB);
L_{tx} is the cable/insertion loss of the commercial transmitter (dB);
L_{rx} is the cable/insertion loss of the public safety receiver (dB).

In equation 1, the FDR term is the reduction in the received power of a signal resulting from the on-tune rejection (OTR) and off-frequency rejection (OFR) of a receiver to the emission

spectrum of an interfering signal.[1] OTR and OFR result when only a portion of the energy contained in the emission spectrum of an interfering signal occurs at frequencies that are within the tuned selectivity bandwidth of a receiver. OTR occurs when the selectivity bandwidth of a receiver is smaller than the emission bandwidth of the interfering signal. OFR occurs because of the detuning of the receiver with respect to the transmit frequency of the interfering signal. For the purposes of this analysis, the OFR is the out-of-band emission attenuation. In this analysis the out-of-band attenuation of 43 + 10 Log (Power) recommended by US West will be used. The OTR is calculated using:

$$OTR = 10 \text{ Log } (B_T/B_R) \qquad \text{for } B_T > B_R$$

$$OTR = 0 \qquad \text{for } B_T \quad B_R$$

Solving equation 1 for the propagation loss yields:

$$L_P = P_T + G_T + G_R - I - OFR - OTR - L_{tx} - L_{rx}$$

$$L_P = P_T + G_T + G_R - I - (43 + 10 \text{ Log}(p_T)) - 10 \text{ Log}(B_T/B_R) - L_{tx} - L_{rx} \qquad (2)$$

where p_T is the transmitter power in Watts.

As previously stated in this proceeding, the level of allowable interference appropriate for mission-critical public safety applications is 6 dB below the noise floor of the receiver.[2] This level will result in a 1 dB increase in the noise floor of the public safety receiver. For a 6.25 kHz bandwidth receiver the thermal noise floor is -136 dBm. Typical receiver noise figures range from 8 to 10 dB. This means that the receiver internal noise floor will range from -126 dBm to -128 dBm, which is consistent with the levels stated previously in this proceeding. Therefore, a reasonable level for the interference threshold to be used in this analysis for public safety receivers is given by:

$$I = -126 - 6 = -132 \text{ dBm}$$

Substituting this interference threshold into equation 2 will give the propagation loss that is required to preclude interference to a public safety receiver.

From the propagation loss computed in equation 2, the distance separation that is required to preclude interference to a public safety receiver can be determined from the equation below:

$$20 \text{ Log } D_{Sep} = L_P - 20 \text{ Log } F - 32.45 - L_{Clutter} \qquad (3)$$

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[1] Krebler, W., Cameron, S., *The Definition of Frequency Dependent Rejection*, IEEE Transactions on Electromagnetic Compatibility, Vol. EMC-21, (Nov. 1979), at 349.

[2] *Ex Parte* Comments, WT Docket. No. 99-168: Motorola Inc. (Dec. 2, 1999) at 2; FreeSpace Communications (Nov. 24, 1999) at 3; and the Federal Law Enforcement Wireless Users Group (Dec. 9, 1999) at 6.

where

F is the frequency of the commercial transmitter (MHz);
D_{Sep} is the distance separation between the commercial transmitter and the public safety receiver that is required to preclude interference (km);
$L_{Clutter}$ is the local clutter loss attenuation factor (dB).

ANALYSIS OF INTERFERENCE SCENARIOS

Commercial Base Transmitter and Public Safety Mobile Receiver

To assess whether the out-of-band emission limit recommended by US West for commercial base transmitters operating in the 747-762 MHz will protect public safety mobile receivers in the 764-776 MHz band this analysis will consider the following technical factors:

- 100 W commercial base transmitter power;
- 10 dBi commercial base transmitter antenna gain;[3]
- 2 dB commercial base transmitter insertion/cable losses;
- 762 MHz commercial base transmitter frequency;
- 6.25 kHz, 250 kHz, 500 kHz, and 1 MHz commercial base transmitter bandwidths;
- 6.25 kHz public safety mobile receiver bandwidth;[4]
- 0 dBi public safety mobile receiver antenna gain;
- 0 dB public safety mobile receiver insertion/cable losses;
- 5 dB clutter loss factor.

Using equations 1 through 3, the distance separations that are required to preclude interference to a public safety mobile receiver are given in Table A-1.

Table A-1. Required Distance Separations Between a Commercial Base Transmitter and a Public Safety Mobile Receiver to Preclude Interference
(Out-of-Band Emission Limit: 43 + 10 Log (Power))

Commercial Transmitter Bandwidth	Distance Separation Required to Preclude Interference
6.25 kHz	39.4 km
250 kHz	6.2 km
500 kHz	4.4 km
1 MHz	3.1 km

The distance separations shown in Table A-1 represent the geographic area (interference zone) around a commercial base station transmitter where the reception of a public safety mobile receiver will be degraded. As shown in Table A-1, these interference zones can be quite large.

[3] Mobile Cellular Telecommunications Analog and Digital Systems Second Edition, William C. Y. Lee, at 167.
[4] 6.25 kHz represents the channel bandwidth for the public safety receivers. The Equivalent Noise Bandwidth of the receiver is narrower than the channel bandwidth.

Furthermore, depending on the number of transmitters a large percentage of the public safety system coverage area would be impacted.

Commercial Base Transmitter and Public Safety Base Receiver

To assess whether the out-of-band emission limit recommended by US West for commercial base transmitters operating in the 747-762 MHz will protect public safety base receivers in the 794-806 MHz band this analysis will consider the following technical factors:

- 100 W commercial base transmitter power;
- 10 dBi commercial base transmitter antenna gain;
- 2 dB commercial base transmitter insertion/cable losses;
- 762 MHz commercial base transmitter frequency;
- 6.25 kHz, 250 kHz, 500 kHz, and 1 MHz commercial base transmitter bandwidths;
- 6.25 kHz public safety base receiver bandwidth;
- 8 dBi public safety base receiver antenna gain;
- -1 dB public safety base receiver insertion/cable losses;
- 0 dB clutter loss factor.

Using equations 1 through 3 the distance separations that are required to preclude interference to a public safety base receiver are given in Table A-2.

Table A-2. Required Distance Separations Between a Commercial Base Transmitter and a Public Safety Base Receiver to Preclude Interference
(Out-of-Band Emission Limit: 43 + 10 Log (Power))

Commercial Transmitter Bandwidth	Distance Separation Required to Preclude Interference
6.25 kHz	197.5 km
250 kHz	31.2 km
500 kHz	22.1 km
1 MHz	15.6 km

When the out-of-band emissions from a commercial base transmitter interfere with a public safety base receiver, the transmissions from a public safety mobile transmitter located at the fringe of the coverage area will be degraded. This effectively results in a reduction of the coverage area of the public safety base station. As shown in Table A-2, the distance at which commercial transmitters can degrade the reception of public safety base receivers is unmanageable.

Commercial Mobile Transmitter and Public Safety Mobile Receiver

To assess whether the out-of-band emission limit recommended by US West for commercial mobile transmitters operating in the 777-792 MHz will protect public safety mobile receivers in the 764-776 MHz band this analysis will consider the following technical factors:

- 30 W commercial mobile transmitter power;
- 0 dBi commercial mobile transmitter antenna gain;
- 2 dB commercial mobile transmitter insertion/cable losses;
- 792 MHz commercial mobile transmitter frequency;
- 6.25 kHz, 250 kHz, 500 kHz, and 1 MHz commercial mobile transmitter bandwidths;
- 6.25 kHz public safety mobile receiver bandwidth;
- 0 dBi public safety mobile receiver antenna gain;
- 0 dB public safety mobile receiver insertion/cable losses;
- 10 dB clutter loss factor.

Using equations 1 through 3 the distance separations that are required to preclude interference to a public safety mobile receiver are given in Table A-3.

Table A-3. Required Distance Separation Between a Commercial Mobile Transmitter and a Public Safety Mobile Receiver to Preclude Interference
(Out-of-Band Emission Limit: 43 + 10 Log (Power))

Commercial Transmitter Bandwidth	Distance Separation Required to Preclude Interference
6.25 kHz	6.7 km
250 kHz	1.1 km
500 kHz	754 m
1 MHz	533 m

Commercial Mobile Transmitter and Public Safety Base Receiver

To assess whether the out-of-band emission limit recommended by US West for commercial mobile transmitters operating in the 777-792 MHz will protect public safety base receivers in the 794-806 MHz band this analysis will consider the following technical factors:

- 30 W commercial mobile transmitter power;
- 0 dBi commercial mobile transmitter antenna gain;
- 2 dB commercial mobile transmitter insertion/cable losses;
- 792 MHz commercial mobile transmitter frequency;
- 6.25 kHz, 250 kHz, 500 kHz, and 1 MHz commercial mobile transmitter bandwidths;
- 6.25 kHz public safety base receiver bandwidth;
- 8 dBi public safety base receiver antenna gain;
- -1 dB public safety base receiver insertion/cable losses;
- - 5 dB clutter loss factor.

Using equations 1 through 3 the distance separations that are required to preclude interference to a public safety base receiver are given in Table A-4.

Table A-4. Required Distance Separation Between a Commercial Mobile Transmitter and a Public Safety Base Receiver to Preclude Interference
(Out-of-Band Emission Limit: 43 + 10 Log (Power))

Commercial Transmitter Bandwidth	Distance Separation Required to Preclude Interference
6.25 kHz	30.1 km
250 kHz	4.8 km
500 kHz	3.4 km
1 MHz	2.4 km

CONCLUSION

As shown in this analysis the distance separations that are required between a commercial base or mobile transmitter with an out-of-band emission limit of 43 + 10 Log (Power) and public safety receivers are large. The results of this analysis support the Commission's decision to adopt more stringent out-of-band emission limits for commercial transmitters operating in the 700 MHz bands in order to provide adequate protection to public safety receivers operating in the adjacent bands.

ATTACHMENT B

ANALYSIS OF US WEST OUT-OF-BAND EMISSION LIMIT PROPOSAL FOR BASE TRANSMITTERS OPERATING IN THE 700 MHz BANDS

INTRODUCTION

In their petition US West recommended a limit for the out-of-band emissions of commercial base transmitters operating in the 700 MHz bands of 65 + 10 Log (Power). This out-of-band emission limit would be applicable for base transmitters with antenna heights of less than 30 feet (height above average terrain).[1] This analysis will determine the potential interference to public safety base and mobile receivers from commercial base transmitters that comply with the out-of-band emission limit of 65 + 10 Log (Power). The potential for interference will be expressed in terms of the distance separation that is required to preclude interference to public safety receivers.

MAXIMUM LINE-OF-SIGHT DISTANCE FOR BASE TRANSMITTERS

The maximum line-of-sight (LOS) distance that can be theoretically achieved is given approximately by:

$$D_{LOS} = 3.57\, k^{1/2}((ht)^{1/2} + (hr)^{1/2})$$

where

D_{LOS} is the maximum line of sight distance (km);
ht is the height of the transmitter (m);
hr is the height of the receiver (m);
k is the effective earth radius.[2]

For a 30 ft (9 meter) base transmitter antenna, a 305 m base receiver antenna, and 2 m mobile receiver antenna the maximum LOS distances are:

Commercial Base-to-Public Safety Base: $D_{LOS} = 84$ km
Commercial Base-to-Public Safety Mobile: $D_{LOS} = 18$ km

The LOS distances given above provide a upper bound for the interference regions around a base transmitter antenna at 30 ft. However, it is difficult to achieve such maximum distances in practice, since obstructions along the propagation path will affect the signal's range. Signals might be blocked or reflected by buildings or other objects, diffracted over and around mountain

[1] The height above average terrain is a measure of antenna height that reflects the characteristics of terrain surrounding the antenna site.
[2] A typical value for k in temperate climates is 1.33.

peaks and ridges and the corners of structures, or even travel much longer distances than normal because of anomalous atmospheric ducting. Although the maximum line-of-sight distances are not achievable the distances at which a base transmitter with an antenna of 30 ft. can interfere with a public safety base or mobile receiver can be large.

ANALYSIS OF INTERFERENCE SCENARIOS

In order to assess the impact to adjacent band public safety base and mobile receivers from commercial base transmitters with a limit on out-of-band emissions of 65 + 10 Log (Power) two interference scenarios will be considered:

1) commercial base transmitter and public safety base receiver;
2) commercial base transmitter and public safety mobile receiver.

The methodology described in Attachment A will be used in this analysis. The maximum effective radiated power limit of 1000 Watts adopted by the Commission in the First R&O will be used for the commercial base transmitters.

Commercial Base Transmitter and Public Safety Base Receiver

To assess whether the out-of-band emission limit of 65 + 10 Log (Power) that was recommended by US West for commercial base transmitters operating in the 747-762 MHz will provide adequate protection to public safety base receivers in the 794-806 MHz band this analysis will consider the following technical factors:

- 100 W commercial base transmitter power;
- 10 dBi commercial base transmitter antenna gain;
- 2 dB commercial base transmitter insertion/cable losses;
- 762 MHz commercial base transmitter frequency;
- 6.25 kHz, 250 kHz, 500 kHz, and 1 MHz commercial base transmitter bandwidths;
- 6.25 kHz public safety base receiver bandwidth;
- 8 dBi public safety base receiver antenna gain;
- -1 dB public safety base receiver insertion/cable losses;
- 0 dB clutter loss factor.

Using equations 1 through 3 of Attachment A, the distance separations that are required to preclude interference to a public safety base receiver are given in Table B-1.

Table B-1. Required Distance Separations Between a Commercial Base Transmitter and a Public Safety Base Receiver to Preclude Interference
(Out-of-Band Emission Limit: 65 + 10 Log (Power))

Commercial Transmitter Bandwidth	Distance Separation Required to Preclude Interference
6.25 kHz	15.7 km
250 kHz	2.5 km
500 kHz	1.8 km
1 MHz	1.2 km

When the out-of-band emissions from a commercial base transmitter interfere with a public safety base receiver, the transmissions from a public safety mobile transmitter located at the fringe of the coverage area will be degraded. This effectively results in a reduction of the coverage area of the public safety base station. As shown in Table B-1, the distances at which commercial base transmitters can degrade the reception of public safety base receivers are large.

Commercial Base Transmitter and Public Safety Mobile Receiver

To assess whether the out-of-band emission limit recommended by US West for commercial base transmitters operating in the 747-762 MHz will provide adequate protection to public safety mobile receivers in the 764-776 MHz band this analysis will consider the following technical factors:

- 100 W commercial base transmitter power;
- 10 dBi commercial base transmitter antenna gain;
- 2 dB commercial base transmitter insertion/cable losses;
- 762 MHz commercial base transmitter frequency;
- 6.25 kHz, 250 kHz, 500 kHz, and 1 MHz commercial base transmitter bandwidths;
- 6.25 kHz public safety mobile receiver bandwidth;
- 0 dBi public safety mobile receiver antenna gain;
- 0 dB public safety mobile receiver insertion/cable losses;
- 5 dB clutter loss factor.

Using equations 1 through 3 of Attachment A, the distance separations that are required to preclude interference to a public safety mobile receiver are given in Table B-2.

Table B-2. Required Distance Separations Between a Commercial Base Transmitter and a Public Safety Mobile Receiver to Preclude Interference
(Out-of-Band Emission Limit: 65 + 10 Log (Power))

Commercial Transmitter Bandwidth	Distance Separation Required to Preclude Interference
6.25 kHz	3.9 km
250 kHz	623 m
500 kHz	441 m
1 MHz	312 m

The distance separations shown in Table B-2 represent the geographic area (interference zone) around a commercial base station transmitter where public safety mobile receiver reception will be degraded. As shown in Table B-2, these interference zones can be quite large. Furthermore, depending on the number of transmitters a large percentage of the public safety system coverage area would be impacted.

CONCLUSION

As shown in this analysis, the distance separations that are required between a commercial base transmitter with an out-of-band emission limit of 65 + 10 Log(Power) and public safety base and mobile receivers are large. The results of this analysis support the Commission's decision to adopt a more stringent out-of-band emission limit for commercial base transmitters operating in the 700 MHz bands in order to provide adequate protection to public safety receivers operating in the adjacent bands.

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Washington, DC 20554

In the Matter of	)	
Service Rules for the 746–764 and 776–794 MHz Bands, and Revisions to Part 27 of the Commission's Rules	)	WT Docket No. 99–168

CERTIFICATE OF SERVICE

I, David A. Williams, Senior Associate, Booz·Allen & Hamilton, Inc., 8283 Greensboro Drive, McLean, Virginia, 22102-3838, hereby certify that on this date I caused to be served, by first-class mail, postage prepaid (or by hand where noted) copies of the Federal Law Enforcement Wireless Users Group's Petition for Reconsideration regarding the Commission's First Report and Order *In the Matter of Service Rules for the 746–764 and 776–794 MHz Bands, and Revisions to Part 27 of the Commission's Rules* the original of which is filed herewith and upon the parties identified on the attached service list.

DATED at Fair Oaks, Virginia this 10th day of March 2000.

David A. Williams

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*The Honorable Susan Ness, Commissioner
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